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Progress Report, April 1995

Zinc Selenide Substrates for Blue Lasers

(For Dr. Yoon Soo Park, ONR 312)

Contract N00014-95-C-0065, Office of Naval Research

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A new crucible was designed for the zone melting growth of zinc selenide (ZnSe). This is partially compatible with the old crucible, in that most of the parts are interchangeable. The seeding area has been reduced to 6 mm diameter at the bottom, but the full 25 mm boule diameter has been reached by 30 mm above the bottom. This allows a seeding neck of considerably smaller diameter than the single crystal grain size in the case of a round bottom crucible. The transition to the full diameter is gradual, with the radii of curvature exceeding 50 mm.

Design of a new control system has begun. This will be based on optical sensing in a closed-loop configuration. Previously, open-loop power control had been used, with circuitry modified to reduce fluctuations; these modifications will be utilized to damp out the oscillations around the set point that are common in tight control systems.

Photoluminescence in the near band edge region has been measured by several collaborators. Strong excitonic luminescence at 2.80 eV was observed, despite the large amount of added fluorine. Donor-acceptor pair luminescence at 2.71 eV was observed; this is generally attributed to nitrogen acceptors. Both these facts indicate that the fluorine-originated donors may be compensated by nitrogen acceptors. Nitrogen was originally used as the blanketing gas because of its higher breakdown threshold, an advantage in our growth process. However, because of this, substitution of argon in the growth process is planned.

Laue X-ray patterns taken by several collaborators have shown highly variable results, depending on position on the wafer, and the position of the wafer within the boule. Some good sharp patterns have been observed; poor patterns seem generally to be the result of twinning, rather than strain. Twinned regions have been optically detected using crossed polarizers; this technique is expected to be helpful in judging the effect of process modifications. In the past, material grown by a melt process has had only small twin-free areas, presumably because the phase transition near the melting point results in the introduction of twins. At the present time, use of a solvent (zinc fluoride) and a non-stoichiometric melt have resulted in large apparently twin-free areas, possibly because the melting point has been lowered to near or below the phase transition. (In this case, the stoichiometric melting point is at 1520 C, and the phase transition is at 1425 C). The twin-free areas appear to be about 50 % of the total at present.

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N00014-95-C-0065
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FOR BLUE LASERS

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